**Unit 10: Immune System Review**

Ms. Ottolini, AP Biology, 2012-2013

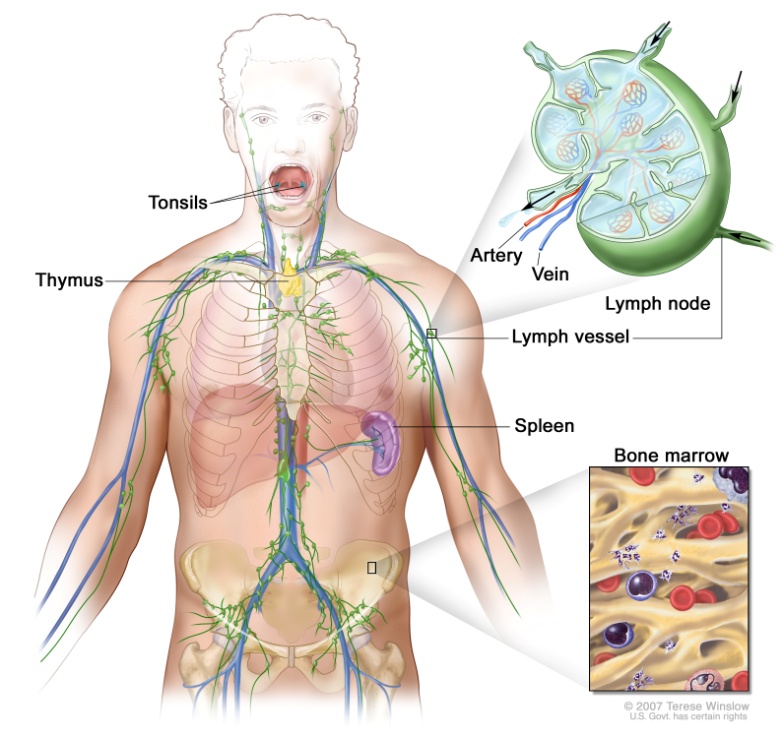
***Why do organisms need an immune system?***

* Protection from **external pathogens** (ex: bacteria, viruses, fungi, and parasitic protists)

1. Enter the body through the following routes: digestive system, respiratory system, urogenital system, or a break in the skin)
2. Travel through the body using the following transport systems: circulatory system and lymphatic system

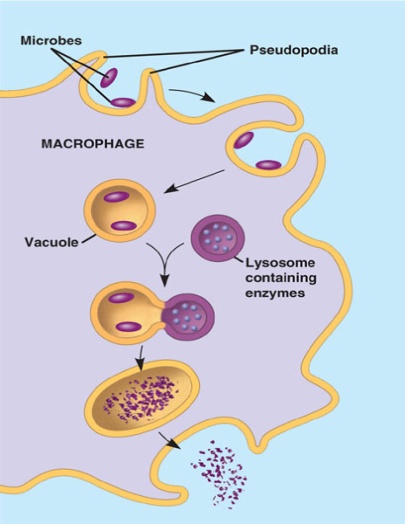
* Protection from internal attack by **abnormal human body cells** (ex: cancer cells)

***What organs and tissues are considered part of the human immune system?***

* **Lymph vessels** = tubes that run parallel to the circulatory vessels (arteries and veins) and serve as a blood filtration system to remove foreign particles
* **Lymph nodes** = oval shaped organs in the armpits, neck, etc. that are connected to lymph vessels ; they collect foreign particles and store B and T lymphocyte cells
* **Spleen** = stores blood cells ; removes clumped pathogens coated with antibodies from the blood stream
* **Adenoids (aka tonsils)** = trap pathogens
* **Bone Marrow** = stem cells within the bone marrow differentiate into blood cells ; location where the B lymphocytes (aka B cells) mature
* **Thymus** = organ in the neck that is used to create and promote maturation of T lymphocytes (aka T cells)

***What defenses are most organisms born with?***

* Plants and all animals have **nonspecific (aka innate/natural) immune responses** that they are born with ; these responses attack any pathogen that tries to invade the body in the same way
* Example in Plants: **Hypersensitivity response** (cells that come in direct contact with the pathogen undergo apoptosis and signal other nearby cells to improve defenses in their cell walls)
* Examples in Humans:

1. First Line of Defense: External Barriers
2. **Physical Barriers**: Skin; mucous membranes in the eyes, nose, anus, etc ; cilia lining the respiratory tract (sweep out pathogens)
3. **Chemical Barriers**: Sweat (pH 3-5), tears + saliva (contain an enzyme called lysozyme that digests bacterial cell walls), stomach acid (hydrochloric acid is at pH 2)
4. Second Line of Defense: Internal Barriers
5. **Leukocytes** (phagocytic white blood cells that “swallow” any foreign particle)

Ex: Macrophages

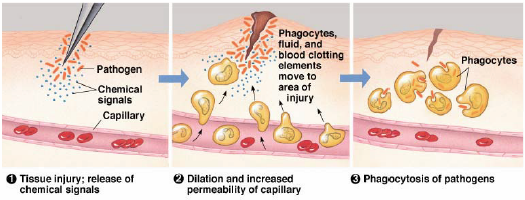
1. **The Inflammatory Response:**

-cells release histamine (causes dilation / widening of blood vessels)

-increased blood supply to the injury causes redness, warmth, and swelling

-blood brings leukocytes to the area to “swallow” and digest pathogens

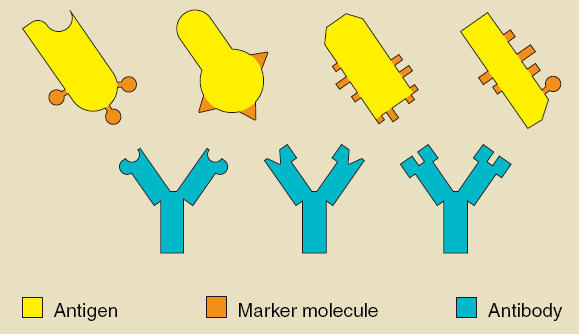
-**Fever** = widespread inflammatory response; higher body temperature interferes with bacterial and viral activity



***What defenses do organisms develop throughout their lifespan?***

* Vertebrates have **specific (aka acquired) immune responses** that they develop over time in response to encounters with specific pathogens
* Example in Humans: ***\*\*\*see diagram given in class to summarize the human immune response\*\*\****

1. A specific type of macrophage called an **antigen –presenting cell (aka APC**), which is part of the innate immune system, swallows an antigen released by a pathogen, chops it up, and presents it on its cell surface

(**Antigen** = a molecule (usually a protein or carbohydrate) found on the surface of a pathogen or released by a pathogen that triggers the production of specific immunity molecules called **antibodies**)

1. The APC binds with a **helper T cell**, which initiates the specific immune response
2. Helper T cells trigger the differentiation of several types of **lymphocytes** (specific types of leukocytes, or white blood cells)
3. **B lymphocytes (aka B cells)** – come in two forms, plasma B cells and memory B cells

-**plasma B cells** actively make antibodies to bind to the antigen presented by the original APC

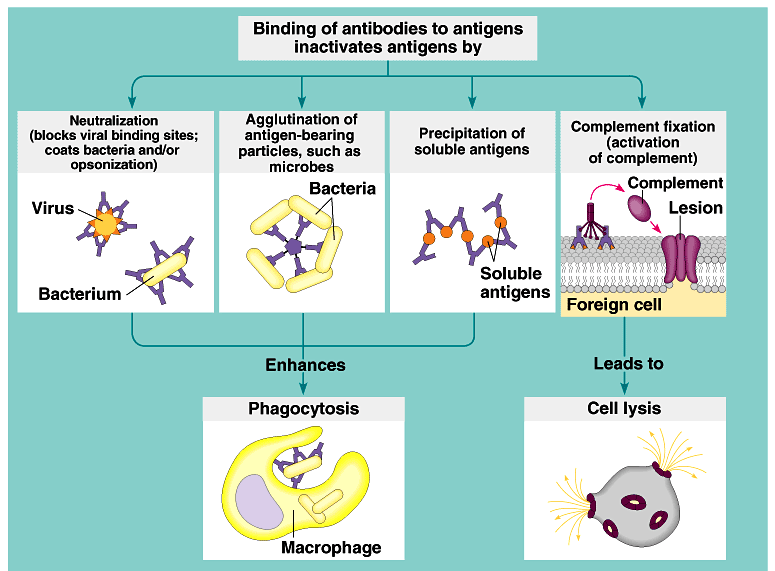
-**Antibodies** = Y shaped proteins with tips that bind specifically to a particular antigen and cause clumping of multiple antigens; this clumping signals a macrophage to swallow the clump and digest it

-**memory B cells** are made to prevent an infection by the same pathogen years later; they can be converted quickly into plasma B cells

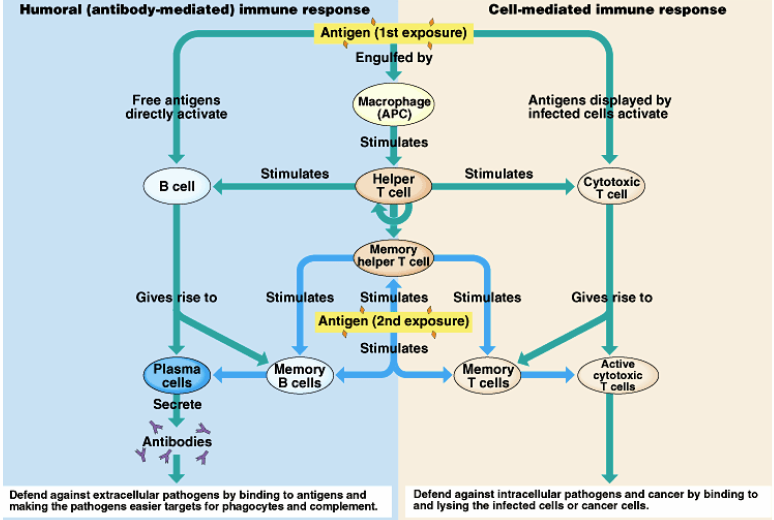
-B cells are part of **Humoral Immunity** (regulates destruction of pathogens in the body fluids – blood, saliva, tears, etc.—that have not yet infected a body cell)

1. **T lymphocytes** (aka T cells, cytotoxic T cells, or killer T cells) – come in two forms, active cytotoxic T cells or memory cytotoxic T cells

-**active cytotoxic T cells** bind to the antigens displayed on infected body cells and release **perforins** (protein molecules) to break open the pathogens cell membrane and induce cell death

-**memory cytotoxic T cells** are made to prevent an infection by the same pathogen years later ; they can be converted quickly into active cytotoxic T cells

-Cytotoxic T cells are part of **Cell-Mediated Immunity** (regulates destruction of body cells that have been infected by a particular pathogen)



***Why can’t humans “catch” the same infection twice?***

* Memory B and cytotoxic T cells can quickly develop into plasma B cells and active cytotoxic T cells to rapidly eradicate a pathogen recognized by the body
* This is called the **secondary immune response**

***What is the difference between passive and active immunity?***

* **Active immunity** involves an individual making his/her own antibodies, which are long-lasting

-Natural = antibodies produced by B cells in response to infection by a particular pathogen

-Artificial = antibodies produced by B cells in response to a **vaccine** (weakened / killed antigen)

* **Passive immunity** involves antibodies being transferred from another organism, which are short-lasting

-Natural = mothers pass antibodies to their fetus via the placenta and newborn via breast milk

-Artificial = antibodies produced by a mouse in response to a pathogen can be injected into human tissue to protect against the same pathogen

***What are autoimmune diseases?***

* **Autoimmune diseases** occur when the T cells and B cells fail to recognize the body cells as “self cells” and attack them as they would a pathogen
* Ex: Type 1 diabetes, lupus, multiple sclerosis, rheumatoid arthritis, psoriasis

***Why is HIV so harmful to the human body?***

* **HIV** = human immunodeficiency virus
* The HIV virus attacks the body’s Helper T cells, so that the body cannot create new cytotoxic T cells or B cells to fight against other, unrelated infections (ex: pneumonia, tuberculosis)
* When the Helper T cell count drops below 200 cells per cubic millimeter of blood, a patient has **AIDS** (acquired immunodeficiency syndrome) ; normally, a healthy individual’s T cell count ranges from 500 to 1800 cells per cubic millimeter of blood
* So in other words, HIV is the virus that causes the condition AIDS
* People who have AIDS typically die due to an inability to fight off other infections